# VOLUME CONTENTS

**Volume 17 Number 1**

## PROCEEDINGS OF THE 1st YUGOSLAV SYMPOSIUM ON SSNTDs

Belgrade, Yugoslavia

28–30 September 1988


| | | |
|---|---|---|
| | vii | List of participants |
| **J. B. Vuković, R. Brandt** and **R. Ilić** | 1 | Editorial |
| **R. Antanasijević** | 5 | Twenty years of SSNTD studies in Yugoslavia |
| **R. Ilić** | 7 | The use of SSNTDs in materials science and technology |
| **R. Brandt, V. S. Butsev, H. H. Cui, E. Ganssauge, G. Haase, M. Heck, M. I. Krivopustov, B. A. Kulakov, E.-J. Langrock, F. Pille** and **W. Schulz** | 9 | Recent advances in the investigation of Cu-targets with relativistic heavy ions, also using SSNTD |
| **M. Fujii, R. Yokota** and **Y. Atarashi** | 19 | Development of polymeric track detectors of high sensitivity |
| **Ž. Todorović** | 23 | Makrofol track detectors: application in high energy nuclear physics |
| **M. Jurić, O. Adamović, Dj. Krmpotić** and **J. Puzović** | 27 | Total disintegration of $^{47}$Ag and $^{35}$Br nuclei exposed in nuclear emulsions to protons and pions of 300 GeV |
| **I. Hunyadi** | 31 | Low energy charged particle nuclear reaction studies with SSNTDs |
| **B. Grabež** | 39 | Application of SSNTDs in investigations of high energy nucleus–nucleus collisions |
| **L. Tommasino** | 43 | Radon monitoring by alpha track detection |
| **M. Najžer** and **T. Šutej** | 49 | Passive dosimeter for radon determination in the environment |
| **L. Medveczky** | 51 | Calibration of, and measurements with, a neutron dosimeter consisting of fission foils and an SSNTD |
| **B. Jakupi, M. Bytyci, Ž. Todorović, R. Antanasijević, V. P. Perelygin** and **S. G. Stetsenko** | 55 | Tracks of heavy charged particles in some natural minerals |
| **J. Rant** | 59 | Neutron radiography with SSNTDs |
| **J. B. Vuković** | 61 | The application of SSNTDs and nuclear emulsions in the life sciences |
| *Abstracts* | 65 | Abstracts of contributed papers |
| *Erratum* | 83 | |
| *Author Index* | 85 | |
| *New Patents* | i | |


**Volume 17 Number 2**

## SPACE RADIATION AND RADIOBIOLOGICAL INVESTIGATIONS OF BIOSATELLITE COSMOS 1887


| | | |
|---|---|---|
| | iv | Preface |
| **V. E. Dudkin, Yu. V. Potapov, A. B. Akopova, L. V. Melkumyan, E. V. Benton** and **A. L. Frank** | 87 | Differential neutron energy spectra measured on spacecraft in low Earth orbit |

**A. B. Akopova, N. V. Magradze, V. E. Dudkin, E. E. Kovalev, Yu. V. Potapov, E. V. Benton, A. L. Frank, E. R. Benton, T. A. Parnell** and **J. W. Watts Jr** 93 Linear energy transfer (LET) spectra of cosmic radiation in low Earth orbit

**G. Reitz, H. Bücker, R. Facius, R. Beaujean** and **W. Enge** 99 Dosimetry results of Cosmos 1887

**Yu. A. Akatov, V. E. Dudkin, E. E. Kovalev, E. V. Benton, A. L. Frank, J. W. Watts Jr** and **T. A. Parnell** 105 Depth distribution of absorbed dose on the external surface of Cosmos 1887 biosatellite

**J. Charvát, F. Spurný, B. Kopecká** and **I. Votočková** 109 Ionizing radiation fluxes and dose measurement during the Kosmos 1887 satellite flight

**A. M. Marenny, G. P. Guertzen** and **R. A. Nymmik** 113 Charge state distribution of anomalous oxygen ions in low Earth orbit during solar quiescence

**P. Schmidt, J. Fellinger** and **K. Hübner** 117 Determination of dose distribution of cosmic radiation behind different shielding thicknesses

**R. Facius, G. Reitz, H. Bücker, L. V. Nevzgodina, E. N. Maximova, E. V. Kaminskaya, A. I. Vikrov, A. M. Marenny** and **Yu. A. Akatov** 121 Reliability of trajectory identification for cosmic heavy ions and cytogenetic effects of their passage through plant seeds

**Y. Gaubin, M. Delpoux, B. Pianezzi, G. Gasset, C. Heilmann** and **H. Planel** 133 Investigations of the effects of cosmic rays on *Artemia* cysts and tobacco seeds; results of Exobloc II experiment, flown aboard Biocosmos 1887

**G. Reitz, H. Bücker, W. Rüther, E. H. Graul, R. Beaujean, W. Enge, W. Heinrich, D. A. M. Mesland, A. M. Alpatov, I. A. Ushakov** and **Yu. A. Zachvatkin** 145 Effects on ontogenesis of *Carausius morosus* hit by cosmic heavy ions

**A. R. Kranz, U. Bork, H. Bücker** and **G. Reitz** 155 Biological damage induced by ionizing cosmic rays in dry *Arabidopsis* seeds

**I. D. Anikeeva, Yu. A. Akatov, E. N. Vaulina, L. N. Kostina, A. M. Marenny, A. I. Portman, S. V. Rusin** and **E. V. Benton** 167 Radiobiological experiments with plant seeds aboard the biosatellite Kosmos 1887

**B. Baican, E. Schopper, Th. Wendnagel** and **J. U. Schott** 173 Biokosmos 8 experiment: dosimetric measurements with AgCl track detectors behind low shielding

*New Patents* I

## Volume 17 Number 3

vii List of participants

A. CHAMBAUDET, M. REBETEZ and M. MARS 179 Editorial

### SECTION A1: FUNDAMENTAL MECHANISM

F. MEMBREY, A. CHAMBAUDET, M. FROMM and R. SAOULI 183 Track etching model for normal incident heavy ion recording in isotropic dielectric detectors

P. YU. APEL, A. YU. DIDYK, L. I. KRAVETS and V. I. KUZNETSOV 191 Track structure in some heavy-ion irradiated plastic films

### SECTION A2: STATISTICS

R. F. GALBRAITH and P. F. GREEN 197 Estimating the component ages in a finite mixture

R. F. GALBRAITH 207 The radial plot: graphical assessment of spread in ages

### SECTION A3: DOSIMETRY

G. BIGAZZI, J. C. HADLER, P. J. IUNES, M. ODDONE, S. R. PAULO and G. POUPEAU 217 On neutron dosimetry: comparison between different dosimeters: preliminary results

T. SUZUKI and K. TOMURA — 223 Neutron dosimetry for fission track dating at irradiation facilities of a TRIGA type reactor

ZHAO YUNLONG — 227 Accurate determination of $\sigma \cdot \phi$ in fission track dating

## SECTION A4: NORMALIZATION

A. J. HURFORD — 233 International Union of Geological Sciences Subcommission on Geochronology recommendation for the standardization of fission track dating calibration and data reporting

D. S. MILLER, N. EBY, R. MCCORKELL, P. E. ROSENBERG and M. SUZUKI — 237 Results of interlaboratory comparison of fission track ages for the 1988 Fission Track Workshop

P. VAN DEN HAUTE and A. CHAMBAUDET — 247 Results of an interlaboratory experiment for the 1988 Fission Track Workshop on a putative apatite standard for internal calibration

## SECTION B1: ANNEALING AND TRACK LENGTHS

S. M. JONES and R. K. DOKKA — 255 Modeling fission track annealing in apatite: an assessment of uncertainties

R. A. DONELICK, M. K. RODEN, J. D. MOOERS, B. S. CARPENTER and D. S. MILLER — 261 Etchable length reduction of induced fission tracks in apatite at room temperature (~23°C): crystallographic orientation effects and "initial" mean lengths

A. S. SANDHU, L. SINGH, R. C. RAMOLA, S. SINGH and H. S. VIRK — 267 Fission track annealing in minerals

## SECTION C1: DATING

Y. GANZAWA, T. HONDA and T. NOZAKI — 273 Absolute measurements of thermal neutron fluence and fission track dating

G. A. WAGNER — 277 Apatite fission-track dating of the crystalline basement of middle Europe: concepts and results

## SECTION C2: THERMAL HISTORY AND UPLIFT

P. A. M. ANDRIESSEN — 285 Anomalous fission track apatite ages of the Precambrian basement in the Hunnedalen region, south-western Norway

A. J. YELLAND — 293 Fission track thermotectonics in the Pyrenean orogen

C. L. E. LEWIS — 301 Thermal history of the Kunlun batholith, N. Tibet, and implications for uplift of the Tibetan plateau

A. CARTER — 309 The thermal history and annealing effects in zircons from the Ordovician of North Wales

S. KOSHIMIZU — 315 Geochronology and thermal history of the Tanzawa pluton, central Japan

D. C. ARNE, P. F. GREEN and I. R. DUDDY — 319 Thermochronologic constraints on the timing of Mississippi Valley-type ore formation from apatite fission track analysis

B. J. KOWALLIS, J. FERGUSON and G. J. JORGENSEN — 325 Uplift along the Salt Lake segment of the Wasatch fault from apatite and zircon fission track dating in the Little Cottonwood stock

S. A. KELLEY and D. D. BLACKWELL — 331 Thermal history of the multi-well experiment (MWX) site, Piceance Creek Basin, northwestern Colorado, derived from fission-track analysis

R. W. BROWN, D. J. RUST, M. A. SUMMERFIELD, A. J. W. GLEADOW and M. C. J. DE WIT — 339 An early Cretaceous phase of accelerated erosion on the south-western margin of Africa: evidence from apatite fission track analysis and the offshore sedimentary record

P. G. FITZGERALD and A. J. W. GLEADOW — 351 New approaches in fission track geochronology as a tectonic tool: examples from the Transantarctic Mountains

E. STUMP, P. G. FITZGERALD and A. J. W. GLEADOW — 359 Comparison through fission-track analysis of portions of Australia and Antarctica adjacent prior to continental drift

P. B. O'SULLIVAN and J. DECKER — 367 Apatite fission track evidence for Paleocene and Oligocene uplift events in the northeastern Brooks Range, Alaska

C. RAVENHURST, R. DONELICK, M. ZENTILLI, P. REYNOLDS and C. BEAUMONT — 373 A fission track pilot study of the thermal effects of rifting on the onshore Nova Scotian margin, Canada

**SECTION C4: APPLICATION TO SEDIMENTARY BASINS**

B. P. KOHN, S. FEINSTEIN and M. EYAL — 381 Cretaceous to present paleothermal gradients, central Negev, Israel: constraints from fission track dating

**SECTION D1: OTHER APPLICATIONS OF URANIUM FISSION TRACKS**

G. BIGAZZI, P. MÁRTON, P. NORELLI and L. ROZLOŽNIK — 391 Fission track dating of Carpathian obsidians and provenance identification

**SECTION D2: AUTOMATIC SYSTEMS**

K. WADATSUMI and S. MASUMOTO — 399 Three-dimensional measurement of fission-tracks: principles and an example in zircon from the Fish Canyon tuff

*Abstracts* — 409 6th International FTD Workshop; 434 Symposium of IUGS–IGCP 196

*Book Reviews* — 441
D. O'SULLIVAN
D. L. HENSHAW

*Erratum* — 443

*Announcement* — 445 International Conference on High Levels of Natural Radiation

*New Patents* — I

## Volume 17 Number 4

**A. Saxena and K. K. Dwivedi** — 447 Mean ranges and energy-loss of $^{86}Kr$ in aluminium, and $^{238}U$ in Hostaphan polymer, by a nuclear track technique

**R. Ilić and M. Najžer** — 453 Image formation in track-etch detectors—I. The large area signal transfer function

**R. Ilić and M. Najžer** — 461 Image formation in track-etch detectors—II. The space-dependent transfer function in thin detectors

**R. Ilić and M. Najžer** — 469 Image formation in track-etch detectors—III. The space-dependent transfer function in thick detectors

**R. Ilić and M. Najžer** — 475 Image formation in track-etch detectors—IV. Image quality

**R. Ilić, J. Rant, T. Šutej, E. Krištof, J. Skvarč, M. Koželj, M. Najžer, M. Humar, M. Čerček, B. Glumac, B. Cvikl, A. Fajgelj, T. Gyergyek, A. Trkov, A. Loose, J. Peternelj, I. Remec and M. Ravnik** — 483 A search for neutrons, protons, tritons, $^{3}He$ ions, gamma- and X-rays from deuterium–deuterium nuclear reaction in electrochemically charged palladium

**A. Tidjani** — 491 Effects of UV light on the efficiency of alpha-particle detection of CR-39, LR-115 type II and CN-85

**A. J. Khan, A. K. Varshney, R. Prasad, R. K. Tyagi and T. V. Ramachandran** — 497 Calibration of a CR-39 plastic track detector for the measurement of radon and its daughters in dwellings

**B. K. Bhaumik and M. Soundararajan** — 503 Statistical evaluation of an optimum radon emanometric technique

**V. A. Guthrie and J. Carpéna** — 507 The hydrothermal system of Auriat (Limousin, France): thermal history as determined by fission track dating

| | | |
|---|---|---|
| **A. D. Franklin, W. F. Hornyak, V. Pagonis and N. Kristianpoller** | 517 | Thermoluminescence study of annealing a geological calcite |
| **R. Debuyst, P. De Cannière and F. Dejehet** | 525 | Axial $CO_2^-$ in alpha-particle irradiated calcite: potential use in ESR dating |
| **M. Takagaki and Y. Mishima** | 531 | Boron-10 quantitative analysis of neutron capture therapy on malignant melanoma by spectrophotometric $\alpha$-track reading |
| **A. M. Rossi and G. Poupeau** | 537 | Radiation damage in bioapatites: the ESR spectrum of irradiated dental enamel revisited |
| **M. Sohrabi and S. Sadeghi Bojd** | 547 | A new dyed ECE track identification method for nuclear particle detection |
| **T. Calderon, A. Millan, F. Jaque and J. Garcia Solé** | 557 | Optical properties of $Sm^{2+}$ and $Eu^{2+}$ in natural fluorite crystals |
| **M. Kasuya, M. Furusawa and M. Ikeya** | 563 | Distributions of paramagnetic centers and alpha-emitters in a zircon single crystal |
| **M. Andersson, M. Jeannin, H. M. Rendell, A. Tardot and P. D. Townsend** | 569 | TL spectra of a mineral mixtures: discrimination between different components |
| **J. S. Yadav and R. K. Singh** | 579 | Change of CR-39(DOP) track detector response as a result of space exposure |
| **D. W. G. Sears, B. M. Myers, C. P. Hartmetz and F. A. Hasan** | 583 | Structural state and anomalous fading of thermoluminescence of oligoclase |
| *Short Communications* | | |
| **T. Bíró, A. Kelemen and I. Pavlicsek** | 587 | Acoustic detection of neutrons by bubble detectors |
| **G. G. Badhwar, L. A. Braby and A. Konradi** | 591 | Real-time measurements of dose and quality factors on board the Space Shuttle |
| **S. Sanzelle, J. Fain, D. Miallier and M. Montret** | 595 | A new method for assessing counting efficiency with LR115 Kodak track detectors |
| *Educational Section* | | |
| **N. Lal, Y. P. Mehta, A. K. Thakur and S. Kumar** | 599 | Nuclear statistics and error analysis using solid state nuclear track detectors: a laboratory experiment |
| *Conference Report* | | |
| **B. C. Bhatt, J. K. Srivastava and K. S. V. Nambi** | 607 | Highlights of the 3rd CECRI Research Conference on Luminescence, held at Karaikudi, Tamil Nadu, India, 12–14 January 1990 |
| *Book Review* | | |
| **P. D. Townsend** | 611 | |
| *Announcements* | 613 | International Symposium on Luminescent Detectors and Transformers of Ionizing Radiation, LUMDETR-91 |
| | | Seventh National Conference on Particle Tracks in Solids |
| *New Patents* | i | |
| *Volume Contents and Author Index, Volume* 17, 1990 | I | |